CLAIMS

1. A system for assessing fruit bunch quality, the system comprising:
an image capturing module (100), for capturing images of one or more fruit bunches;
a processing module (200), for processing the captured images, the processing module (200) comprising:
a calibration module (300), for performing pixel calibration within a field of view of the captured images;
an object detection module (400), for generating at least one bounding box on the captured images, such that each bounding box contains one or more regions of interest on the fruit bunch; and
a segmentation module (800), for generating at least one polygon on the captured images, such that each polygon contains one or more regions of interest on the fruit bunch;
wherein the image capturing module (100) is trained with an object tracking mechanism and a line detection mechanism, for tracking the fruit bunches which are loaded onto a conveyor and defining a virtual line spanning across the conveyor respectively, such that the image capturing of the fruit bunches and the processing of said captured images are triggered upon having said fruit bunches cross the virtual line, with the region of interests within the bounding boxes corresponding to further characteristics of the fruit bunch, including ripeness, damage type, or cleanliness of the fruit bunch, whereas the regions of interests within the polygons corresponds to physical characteristics of the fruit bunch including a size of the fruit bunch and a type of the fruit bunch, in which information from both of object detection module (400) and the segmentation module (800) are collectively assessed and evaluated to be output thereafter.

2. The system as according to claim 1, wherein the image capturing module (100) is

further configured to capture frames containing the fruit bunch from a video medium.

3. The system as according to any one of the preceding claims, wherein the object detection module (400) further comprising a ripeness classification module (500), a damage detection module (600), and a cleanliness module (700).

4. The system as according to claim 3, wherein the ripeness classification module (500) is configured to determine a classification of the fruit bunch.

5. The system as according to claim 3, wherein the damage detection module (600) is configured to detect an extent of damages done to the fruit bunch and classify the fruit bunch as damaged (305a) or undamaged (305b) thereafter.

6. The system as according to claim 3, wherein the cleanliness module (700) is configured to identify a cleanliness level of the fruit bunch, such that the fruit bunch is subsequently labelled dirty (308a) or not dirty (308b).

7. The system as according to any one of the preceding claims, wherein the segmentation module (800) further comprising a stalk detection module (900) and a size estimation module (1000).

8. The system as according to claim 7, wherein the stalk detection module (900) is configured to detect whether the fruit bunch has a long stalk (407a) or not a long stalk (407b).

9. The system as according to claim 7, wherein the size estimation module (1000) is configured to estimate a size of the fruit bunch, such that the fruit bunch is subsequently labelled as small (502a) or not small (502b).

10. The system as according to any one of the preceding claims, further comprising an association module (1100) which is configured to associate the respective characteristics as determined by the object detection module (400) and the segmentation module (800) to each fruit bunch within the captured images.

11. A method for assessing fruit bunch quality comprising the steps of:
capturing, by an image capturing module (100), images of one or more fruit bunches;
processing, by a processing module (200), the captured images using the steps of:
performing, by a calibration module (300), pixel calibration within a field of view of the captured images;
generating, by an object detection module (400), at least one bounding box on the fruit bunch, such that each bounding box contains one or more regions of interest on the fruit bunch; and
generating, by a segmentation module (800), at least one polygon on the captured images, such that each polygon contains one or more regions of interest on the fruit bunch;
wherein the image capturing module (100) is trained with an object tracking mechanism and a line detection mechanism, for tracking the fruit bunches which are loaded onto a conveyor and defining a virtual line spanning across the conveyor respectively, such that the image capturing of the fruit bunches and the processing of said captured images are triggered upon having said fruit bunches cross the virtual line, with the region of interests within the bounding boxes corresponding to further characteristics of the fruit bunch, including ripeness, damage type, or cleanliness of the fruit bunch, whereas the regions of interests within the polygons corresponds to physical characteristics of the fruit bunch including a size of the fruit bunch and a type of the fruit bunch, in which information from both of object detection module (400) and the segmentation module (800) are collectively

assessed and evaluated to be output thereafter.

12. The method as according to claim 11, wherein the pixel calibration is performed by the steps of:

capturing a fiducial marker of a predetermined size within the captured image;

determining a location and a pixel size of the fiducial marker using a computer vision technique; and

calculating a distance per pixel based on the determined location and pixel size of the fiducial marker.

13. The method as according to claim 11, wherein the characteristics of the fruit bunch quality are determined by the steps of:

determining, by a ripeness classification module (500), a classification of ripeness of the fruit bunch;

detecting, by a damage detection module (600), damages on the fruit bunch; and

identifying, by a cleanliness module (700), a cleanliness level of the fruit bunch.

14. The method as according to claim 13, wherein the classification of ripeness of the fruit bunch is determined by the steps of:

applying an object detection technique to obtain confidence scores on the bounding boxes; and

classifying the ripeness of the fruit bunch with a label identification based on the confidence scores of each bounding box.

15. The method as according to claim 13, wherein the damages on the fruit bunch are detected by the steps of:

identifying numbers of damaged fruitlets within the fruit bunch;

comparing the numbers of damaged fruitlets to a predetermined threshold range; and

designating a label identification to the fruit bunch based on the comparison of damaged fruitlets to the predetermined threshold range.

16. The method as according to claim 13, wherein the cleanliness level of the fruit bunch is identified by the steps of:
identifying one or more areas of contamination on the fruit bunch within the regions of interest based on the bounding boxes of the captured images;
measuring the areas of contamination on the fruit bunch;
comparing the measured areas of contamination to a predetermined threshold range; and
designating another label identification to the fruit bunch based on the comparison of the measured areas of contamination to the predetermined threshold range.

17. The method as according to claim 11, wherein the size of the fruit bunch is determined by the steps of:
measuring a contour area from any one segment within the region of interests in the polygons of the captured images of the fruit bunch;
comparing the contour area to a predetermined threshold; and
designating a label identification to the fruit bunch based on the comparison of the contour area to the predetermined threshold.

18. The method as according to claim 11, wherein the size of the fruit bunch is also determined by the steps of:
calibrating a binocular image capturing module (100) to determine intrinsic parameters and extrinsic parameters of said binocular image capturing module (100);
capturing one or more images of the fruit bunch;
rectifying the captured images to ensure at least two captured images are disposed on a same scan line;

identifying corresponding features or key points within the rectified images;

calculating a disparity map between the rectified images;

converting the disparity map to a depth map;

generating a three-dimensional point cloud based on values obtained from the depth map;

normalizing the three-dimensional point cloud using points representing a conveyor floor; and

estimating a volume of the fruit bunch based on the generated three-dimensional point cloud.

19. The method as according to claim 11, wherein the type of fruit bunch is determined by the steps of:

applying one or more label identification on segments in the regions of interest of the captured images correlating to at least one stalk of the fruit bunch and fruitlets of the fruit bunch;

converting the segments containing the fruitlets of the fruit bunch in the captured images into a convex hull area;

identifying an intersection area between the convex hull area and the segments correlating to the stalk of the fruit bunch;

measuring a difference between the segments correlating to the stalk of the fruit bunch and the intersection area, in which the difference corresponds to an excessive stalk area;

generating a minimum bounding box to the excessive stalk area;

converting a height of the excessive stalk to metric dimensions using distance per pixel as calibrated by the calibration module based on the dimensions of the minimum bounding box;

comparing the height of the excessive stalk to a predetermined threshold; and

designating a label identification to the fruit bunch based on the comparison of the height of the excessive stalk.

20. The method as according to claim 11, wherein the information of the characteristics obtained from the object detection module (100) and the segmentation module (800) are associated by the steps of:

matching characteristics of the fruit bunch with at most one fruit bunch in the captured images, such that the matching includes the steps of:

defining at least two lists of nodes representing the individual fruit bunch and the characteristics of the fruit bunches;

iterating through the list of nodes using a suitable association algorithm; and

identifying and designating a label identification of any one of the respective characteristics of the individual fruit bunch to the individual fruit bunch having an intersection percentage value higher than a minimum intersection percentage value.